REMARKS

This Amendment is a submission in accordance with 37 C.F.R. §1.114. This Amendment is being filed concurrently with a Request for Continued Examination.

Claims 1-3, 5, 8-12, 14-17, 31-32, 35, 37-42 and 44-46 are pending in this application. By this Amendment, claims 1, 5, 12, 15 and 31 are amended, claims 4, 6, 7, 36 and 43 are canceled without prejudice or disclaimer and new claims 44-46 are added. Various amendments are made to the claims for clarity and are unrelated to issues of patentability.

The Office Action objects to claim 12 because of informalities. It is respectfully submitted that the above amendment to claim 12 obviates the grounds for objection.

The Office Action rejects claims 1-12, 14 and 37-41 under 35 U.S.C. §103(a) over U.S. Patent 6,653,741 to Sreeram et al. (hereafter Sreeram) in view of "Fluxless and Substantially Voidless Soldering for Semiconductor Chips" by Mizuishi (hereafter Mizuishi). The Office Action also rejects claims 15-17 and 42-43 under 35 U.S.C. §103(a) over Sreeram in view of Mizuishi. Still further, the Office Action rejects claims 31, 32, 35 and 36 under 35 U.S.C. §103(a) over Sreeram in view of Mizuishi. The rejections are respectfully traversed with respect to the pending claims.

Independent claim 1 recites preparing a bonding surface of a heat dissipating member by removing an oxidation layer from the bonding surface and plating the bonding surface with at least one wetting layer. Independent claim 1 also recites bonding a metallic solder thermal interface material to the bonding surface, the thermal interface material to thermally couple the heat dissipating member to a heat conducting component by an

impermanent attachment, the thermal interface material having a melting point of 200°C or less and having a phase change temperature within a range of operating temperatures of a thermally coupled component. The metallic solder thermal interface material comprises indium or an alloy thereof.

Independent claim 1 also recites that the bonding includes: providing a solid piece of the thermal interface material in a vacuum chamber under vacuum conditions, heating the thermal interface material to a temperature below an oxidation temperature of metal in the vacuum and providing a pressurized inert atmosphere in the vacuum chamber to form liquid metallic solder such that gravity reflows the liquid metallic solder over the bonding surface, the pressurized inert atmosphere being from about 15 to about 40 pounds per square inch (p.s.i.), and applying a force to the heat dissipating member to compress the heat dissipating member against the thermal interface material.

The applied references do not teach or suggest at least these features of independent claim 1. More specifically, the applied references do not relate to specific problems of oxidation and TIM layers. See, for example, paragraph [0006] of the present specification. Independent claim 1 relates to a method to improve thermal conducting and achieving a reliable bond in view of oxidation. Sreeram and Mizuishi do not teach or suggest the claimed features, especially with regard to oxidation.

The Office Action cites Sreeram's col. 3, lines 27-30 for features relating to preparing a bonding surface of the heat dissipating surface. However, Sreeram does not teach or suggest preparing a bonding surface by removing an oxidation layer from the bonding surface and plating the bonding surface with at least one wetting layer, as recited

in independent claim 1. Rather, Sreeram specifically discloses that the TIM does not require extrinsic fluxing since the solder of the TIM is activated by an intrinsic oxygen getter that is mixed with the bonding compound. See Sreeram's col. 4, lines 35-42. Mizuishi also does not teach or suggest these specific features relating to removing an oxidation layer from the bonding surface of a heat dissipating member. Accordingly, the applied references do not teach or suggest removing an oxidation layer and therefore the applied references undergo a different process regarding bonding of any alleged metallic solder thermal interface material. The rejection should be withdrawn at least for this reason.

Sreeram and Mizuishi also do not teach or suggest that the bonding includes providing a solid piece of the thermal interface material in a vacuum chamber under vacuum conditions and heating the thermal interface material and providing a pressurized inert atmosphere in the vacuum chamber to form liquid metallic solder such that gravity reflows the liquid metallic solder over the bonding surface. Sreeram does not relate to a pressurized inner atmosphere and therefore does not relate to a pressurized inert atmosphere such that gravity reflows a liquid metallic solder.

The Office Action appears to rely on Mizuishi for features relating to pressure. However, Mizuishi does not teach or suggest providing a pressurized inert atmosphere in the vacuum chamber to form liquid metallic solder such that the gravity reflows the liquid metallic solder over the bonding surface. Rather, Mizuishi discloses that pressure of the atmosphere is increased from P_1 to P_2 to make the solder flow into the previously vacant preformed region. See page 330, col. 2. Additionally, Mizuishi also does not suggest that

the metallic solder thermal interface material comprises indium or an alloy thereof. There is no suggestion that Mizuishi's procedures may be performed on indium or an alloy thereof.

Still further, the applied references do not teach or suggest applying a force to the heat dissipating member to compress the heat dissipating member against the thermal interface material. Mizuishi clearly relates to steps 1-4 to complete the solder bond. These steps do not suggest applying a force to the heat dissipating member to compress the heat dissipating member against the thermal interface material. Sreeram also does not teach these features.

Applicants respectfully submit that the combination of references is improper. The Office Action relies primarily on Sreeram. However, Sreeram discloses a specific thermal interface material for bonding substrates. Sreeram also discloses specifics regarding the bonding. See, for example, col. 3, lines 25-42 and col. 4, line 35-col. 6, line 22. See also col. 7, lines 15-47 discussing the application of the specific TIM to a substrate. Applicants also note that Sreeram provides specific examples of the materials in the TIM. The Office Action then applies Mizuishi to show various features relating to inert atmospheres, vacuums and pressures. However, there is no suggestion in Sreeram or Mizuishi that Mizuishi's procedures may be performed on Sreeram's specific TIM (and result in an operable TIM). Stated differently, subjecting Sreeram's TIM layer to the process of Mizuishi may degrade Sreeram's TIM layer.

The Office Action very clearly relies on impermissible hindsight to combine Sreeram and Mizuishi. There is no suggestion to combine the references as alleged. Rather, the only suggestion of the claimed features is provided in applicants' specification. The Office

Action's suggestion to modify Sreeram's procedure and use of a specific TIM is contrary to Sreeram's teachings at col. 7, lines 15-41 regarding preparation of the TIM. The Office Action appears to overlook these specific teachings when applying Mizuishi.

For at least the reasons set forth above, Sreeram and Mizuishi do not teach or suggest all the features of independent claim 1. Thus, independent claim 1 defines patentable subject matter.

Independent claim 15 recites removing an oxidation layer from a bonding surface of a heat dissipating member, placing a metallic solder and the heat dissipating member into a vacuum chamber where the metallic solder comprises indium or an alloy thereof, and placing the vacuum chamber under vacuum conditions by removing oxygen gas from the vacuum chamber to inhibit oxidation. Independent claim 15 also recites heating the metallic solder to a temperature of greater than or equal to the melting point of the metallic solder to form a liquid metallic solder, the heated temperature being about 10°C to about 300°C, and after heating the metallic solder, purging the vacuum chamber of oxygen gas and providing a pressurized inert atmosphere in the vacuum chamber, the pressurized inert atmosphere having a pressure of from about 0 to 100 pounds per square inch (p.s.i.). Still further, independent claim 15 also recites providing the liquid metallic solder on at least a portion of the bonding surface to form a liquid metallic solder layer, removing at least a portion of the pressurized inert atmosphere from the vacuum chamber, allowing the liquid metallic solder layer to cool to a temperature of less than the melting point of the metallic solder, and applying a force to the heat dissipating member to compress the heat dissipating member against the metallic solder.

For at least similar reasons as set forth above, the applied references do not teach or suggest at least these features of independent claim 15. Thus, independent claim 15 defines patentable subject matter.

Independent claim 31 recites removing an oxidation layer from a bonding surface of a heat dissipating device, providing a solid piece of metallic solder in a vacuum chamber under vacuum conditions by at least removing oxygen gas from the vacuum chamber to inhibit oxidation, where the metallic solder comprises indium or an alloy thereof, and heating the solid piece of the metallic solder to at least a melting temperature of the metallic solder while in the vacuum chamber. Independent claim 31 also recites after heating the metallic solder, providing a pressurized inert atmosphere in the vacuum chamber while the metallic solder is in the vacuum chamber, the pressurized inert atmosphere having a pressure from about 0 to 100 pounds per square inch (p.s.i.). Still further, independent claim 31 recites bonding the heated metallic solder onto the bonding surface without a solder flux while the metallic solder is in the vacuum chamber. Independent claim 31 also recites allowing the heated metallic solder to cool to a temperature less than the melting point of the metallic solder and applying a force to the heat dissipating device to compress the heat dissipating device and the metallic solder.

For at least similar reasons as set forth above, the applied references do not teach or suggest at least these features of independent claim 31. Thus, independent claim 31 defines patentable subject matter.

Accordingly, each of independent claims 1, 15 and 31 define patentable subject matter. Each of the dependent claims depends from one of the independent claims and

therefore defines patentable subject matter at least for this reason. In addition, the dependent claims recite features that further and independently distinguish over the applied references.

CONCLUSION

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Favorable consideration and prompt allowance of claims 1-3, 5, 7-12, 14-17, 31-32, 35, 37-42 and 44-46 are earnestly solicited. If the Examiner believes that any additional changes would place the application in better condition for allowance, the Examiner is invited to contact the undersigned attorney at the telephone number listed below.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this, concurrent and future replies, including extension of time fees, to Deposit Account 16-0607 and please credit any excess fees to such deposit account.

Respectfully submitted,
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